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APPENDIX

PATIENT MANAGEMENT CATEGORIES
AND
DISEASE STAGING:
CAN THEY IMPROVE DRGs?

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1.0 OVERVIEW

Since the adoption of a per case payment for hospital care for Medicare patients, critics have raised serious concerns about the failure of DRGs to account for variability of severity of illness within DRGs. The viability of the PPS system is dependent on how well the averaging principle works. Ideally, the costs of treating more resource-intensive patients for whom the real costs exceed the DRG payment will be balanced with those of the less severely ill patients. However, hospitals that consistently treat the "sicker" patients may not have an opportunity to recoup losses. Concerns with equity of the system has stimulated continued interest in other case mix systems that might replace or augment existing DRGs.

2.0 WHAT ARE THE ALTERNATIVE CASE MIX MEASURES?

Efforts to devise alternative measures of casemix have paralleled the development and subsequent adoption of DRGs as the basis of Medicare's Prospective Payment System. Two state-of-the-art methods, Disease Staging developed by Systemetrics and Patient Management Categories (PMCs) developed at Blue Cross of Western Pennsylvania, can now be tested as alternatives to DRGs because (1) the systems are all-inclusive, and (2) software are available to test them on a large number of cases.

2.1 Description of the Alternative Systems

The Disease Staging and PMC methodologies are not well known and are not nearly as straightforward as the algorithm that assigns DRGs. The systems are described briefly below.

The Disease Staging method classifies patients to account for severity of illness within well defined disease categories. Each disease category represents a distinct disease entity as identified by panels of physicians. Each disease category contain information about the cause, location, manifestation and severity of the problem. By considering the relationship among the combinations of input diagnosis codes, the system selects the most likely underlying condition leading to the admission. (See Section 9.2.3 for a more complete discussion of Staging.)

Patient Management Categories (PMCs) were also defined by physician panels. Unlike DRGs, the categories were defined based on the physicians' clinical knowledge without reference to empirical data. Physicians identified distinct patient types that may be managed similarly. The categories implicitly recognize severity differences among patients with a particular disease only where those distinctions should influence treatment patterns and hospital resource requirements. PMCs can also identify multiple reasons for admission.

Staging and/or PMCs may prove to be a more clinically valid basis for reimbursement. What are the characteristics of the three systems? Table 1 compares the system along four important dimensions. Each of the systems rely on the data available on the hospital discharge abstract: diagnosis(es), procedure, age, sex and disposition at discharge. Further, each is dependent on the ICD-9 CM nomenclature to make category assignments. Disease Staging and PMCs share some characteristics which suggest that they have potential to better measure casemix severity. Of particular interest is the relative sophistication of the Staging and PMC algorithms. There are four areas where they may improve upon DRGs.

First: Staging and PMCs can evaluate all diagnoses regardless of order rather than being tied to the first listed diagnosis.

Second Staging and PMCs can classify patients by identifying two diagnoses that together describe a single, distinct clinical entity.

Third: Staging and PMCs can identify multiple problems and, hence, permit multiple classifications for a single patient because the full array of diagnostic data is used.

Fourth: Relatedly, each system can distinguish related from unrelated comorbidities.

TABLE 1

COMPARISON OF DRGs WITH STAGING AND PATIENT MANAGEMENT CATEGORIES (PHCs)

	DRGs	PHC	Staging
Methodology	- Developed using actual patient discharge data based on cost and length of stay. - Age and specific co-morbid conditions proxy severity. - Category Assignment: splits on surgery/non-surgery.	Developed by MD panels then mapped to ICD-9. Developed unrelated to resource consumption; Categories reflect "typical" patient care. Severity accounted for in the choice of PHC. Some categories split on surgery/non-surgery other categories include cases treated with and without surgery.	Developed by MD panels then mapped to ICD-9. Developed unrelated to resource consumption. Level of severity indicated by ICD-9 data. Presence of surgery does not affect assignment of disease category but may affect assignment of stage within disease category.
Definition of Principal Diagnosis	- Category Assignment based on principal diagnosis. - Order of diagnosis determines assignment to DRG.	Assigns multiple categories based on all diagnoses or combination of diagnoses Order of diagnoses does not affect assignment of categories.	Assigns multiple categories based on all diagnoses or combination of diagnoses. Order of diagnoses does not affect assignment of categories but does affect choice of primary staged condition.
Multiple Category Assignment	Multiple category assignments are impossible.	Five (5) maximum number of categories. Choice among multiple categories is not presently resolved.	Twelve (12) maximum number of categories. The algorithm chooses that with highest staged value as the cause of the admission.
Definition of Comorbidity	- Comorbid conditions are not disease specific - Cannot identify single disease entity defined by more than one diagnostic code.	Comorbid conditions are disease specific Can identify single disease entity defined by more than one diagnostic code.	Comorbid conditions can be defined in a more or less restrictive way Can identify single disease entity defined by more than one diagnostic code.

3.0 DATA BASE

In order to evaluate and compare the relative performance of Disease Staging and PNCs with DRGs, CHER staff ran their software on the merged Michigan Medicare Part A and Part B claims for 1982. This file represents the universe of Medicare admissions for Michigan and includes 300,122 claims. Michigan data provide a very rich basis for analysis of case mix because the claims data include up to five diagnoses and three procedures.

4.0 HOW WELL DO THE ALTERNATIVES WORK?

A comparison of the overall performance of the three systems is shown in Table 2. Using untrimmed data, DRGs explain only 17 percent of the overall variation; PNCs explain about the same and Staging explains only 10 percent. Remarkably, all three perform about the same for (untrimmed) surgical cases, explaining about 35 percent of the variation. And neither alternative improves on the relatively limited performance of DRGs in explaining costs for medical cases.

Table 2 also shows the results using trimmed data that excludes outlier cases having costs more than three standard deviations above the geometric mean. DRGs explain 30 percent of the variation overall, and nearly half of that for surgical cases. However, for medical cases DRGs still account for only 10 percent.

Using trimmed data, the performance of the alternative casemix measures is actually inferior to DRGs. Overall, Disease Staging explains far less of the variation than DRGs (17% vs. 30% for DRGs) while performing about the same for surgical cases. Staging, however, works slightly better than DRGs for the medical cases. PNCs do much better than Disease Staging, but DRGs still explain more of the variation in costs than either system. It isn't surprising that DRGs work better overall because they explicitly distinguish the more expensive surgical cases from medical cases. The alternative systems are unable to improve on the performance of DRGs inspite of the advantage of having more discrete categories.

It would appear that the alternative casemix measures examined here do not represent a viable substitute in toto for DRGs as a basis for hospital reimbursement. However, they may be useful as modifiers for the existing DRGs. If Staging and/or PNCs provide a dimension of casemix that DRGs fail to capture, each may in combination with DRGs improve the overall performance of DRGs. Further tests will show how well PNCs and Disease Staging function in combination with DRGs using selected cases from the Michigan merged A-B Medicare claims file for 1982.

TABLE 2

COMPARISON OF THE VARIATION (R^2) IN HOSPITAL COSTS^a EXPLAINED BY THREE CASE MIX MEASURES

	DRGs		PMCs		Staging	
	Untrimmed	Trimmed**	Untrimmed	Trimmed	Untrimmed	Trimmed
Medical	0.06	0.10	0.07	0.11	0.09	0.13
Surgical	0.34	0.49	0.35	0.51	0.35	0.49
All cases	0.17	0.30	0.15	0.26	0.10	0.17

^aDependent variable is Part A cost.

**Trimmed data exclude outliers, defined as cases exceeding three standard deviations from the geometric mean. DRGs 468 and 470 are excluded.

Source: Merged A-B Medicare Claim Files for Michigan in 1982.

4.1 TRACER METHODOLOGY

In order to further evaluate the relative effectiveness of the alternative methodologies as a basis for DRG refinement, we analyzed cases in two DRG clusters. The tracer represents all possible DRGs within which patients with a given clinical condition might fall. The two tracers included in the analysis are a medical condition, pneumonia, and a condition that may be treated either medically or by several surgical approaches prostatic disease.

For the tracer analyses, we abstracted cases from the 1982 Michigan Medical Part A and Part B merged claims in the constituent DRGs. The pneumonia tracer includes 7,960 cases from DRGs 79, 80, 81, 89, 90, 91. The prostatic disease tracer includes 7,806 cases from DRGs 306, 307, 336, 337, 346-349. (See Table 9-1 for a distribution of cases across DRGs.) The rationale used to define the DRG clusters for each tracer is discussed in detail within Chapter 9.2.2 of this report.

5.0 DRG REFINEMENT USING DISEASE STAGING OR PMCs

One of the first questions that arises in a comparison of DRGs, Disease Staging and PMCs is how similar are the classes of patients that each system creates? A priori, one might assume that both alternatives are highly correlated with DRGs. After all, classification in each of the systems is dependent on the same data: diagnoses, procedures, age and sex.

In actual fact, there is little correlation between DRGs and either Disease Staging or PMC assignments for either tracer condition. A notable exception in the Prostatic Disease tracer is among the cases with cancer which are concentrated in the PMC for neoplasms without an operation. Within Disease Staging, the cases with prostatectomies in DRGs 306 and 307 are concentrated in a category CHER created including several stages related to problems of the urinary tract. Similarly, within the pneumonia tracer, classes created by either Diseases Staging or PMCs are not correlated with DRGs.

There are three ways in which these alternative measures may improve DRGs. First, by fractionating DRGs, they can adjust for intra-DRG severity by identifying cases that are clearly different. Second, by considering all diagnoses or combinations of diagnoses regardless of order, these approaches may correct misclassifications of diseases made by the DRG algorithm. Finally, by providing an improved measure of comorbidity, Staging and/or PMCs may provide an improved method to identify unrelated from related comorbidities.

How well do Staging and PMCs accomplish these objectives? In order to answer these questions, we adopted a stepwise regression approach to evaluate the marginal effect of the two alternative casemix measures in explaining the variation in the cost of physician services. The variables are entered loglinearly so that the coefficients may be interpreted as the percentage change in costs due to each casemix adjustor, all other included variables held constant.

In the first step, dummy variables representing DRGs are entered in the regression with an area wage index to control for difference in costs across areas. In the next step, dummies representing either the Disease Staging categories or PMC categories are added to indicate the amount of additional variation that each of the casemix measures explain over-and-above DRGs. The third step enters a dummy variable for patients over age 80 and another indicating patients who have a comorbid condition that is unrelated to the principal diagnosis. Both casemix measures under consideration were used to define a comorbidity indicator, and each is tested independently. The final step includes two other measures of patient severity: a dummy for patients who died, as well as an indicator for care provided in a teaching hospital.

We applied this strategy to the cases in the two tracer conditions. The incremental effects are shown on Table 3. By observing the change in R^2 down the column for Disease Staging, we have an indicator of the marginal effect of Disease Staging in explaining cost variation, holding DRGs constant. The R^2 for prostatic disease tracer is slightly higher for DRGs alone in the first step because it includes more expensive surgical cases than pneumonia. After controlling for DRGs, Staging adds little to explained costs for either pneumonia or prostatic disease. The addition of unrelated comorbidity fails to explain much more of the variation. The final step leaves 87 percent of variation in costs for pneumonia and 80 percent of the variation in (wage-adjusted) costs for prostatic disease unexplained.

TABLE 3

INCREMENTAL R^2 WITH ADDITIONAL CASE MIX VARIABLES

	<u>Pneumonia</u>		<u>Prostatic Disease</u>	
	R^2 Staging	R^2 PMC	R^2 Staging	R^2 PMC
1. DRGs (price adj.)	.097	.097	.135	.135
2. Staging Dummies	.109	--	.155	--
3. PMC Dummies	--	.108	--	.144
4. Unrelated Comorbidity, Age	.115	.113	.184	.160
5. Died, Teach	.134	.131	.192	.176

Source: Merged A-B Medicare Claim Files for Michigan in 1982.

A comparison of the incremental effect of PNCs yields remarkably similar results. While holding DRGs constant, the addition of PNC dummies explains 10.8 percent of the variation for pneumonia and 14.4 percent of the variation in prostatic disease. The final step increases the R^2 only slightly for both. Comparing the performance of the two systems doesn't offer any clear indication of a superior complement to adjust for severity of illness within DRG.

5.1 Are the Classes Created by the Alternative Systems Meaningful?

Findings suggest that neither alternative case mix system is much of an improvement when superimposed on existing DRGs. In spite of their inability to explain much more of the variation in hospital costs, both systems do identify classes of patients with more similar characteristics, holding DRGs constant.

The coefficients of the Disease Staging and PNCs dummies are shown in Table 4. Definitions for these categories are contained in the Attachment. For the medical cases in the Pneumonia tracer, the coefficients of four Disease Staging dummies are statistically significant at the 1% level. For the cases identified as complicated bacterial pneumonia Stages 2 and 3, costs are 79 and 73 percent higher, respectively, than the uncomplicated pneumonia (the left-out category). Cases identified as Other Respiratory Condition (ORES) are estimated to have costs that are 28 percent lower than the reference group. Further, patients with tuberculosis (TB2) also have a statistically significant coefficient implying costs 27 percent lower than the reference group.

Four PNC dummy variables are also highly significant in the pneumonia cluster. Cases with pneumonia with effusion (EFF), and pneumonia with lung abscess (LUNGAB) have costs that are substantially higher than uncomplicated pneumonia, 47 and 44 percent, respectively. Cases with COPD are six percent more expensive on average than the uncomplicated pneumonias.

Disease Staging identifies five classes of patients that have (statistically) significantly different costs in the prostatic disease cluster. Patients with higher Stage 3 BPH are substantially more expensive (42 percent) than uncomplicated cases. Those BPH patients who die (BPH4) have costs 134 percent higher than the uncomplicated BPH patients. Patients

TABLE 4

COMPARISON OF COEFFICIENTS FOR STAGING AND PHC'S EXPLAINING HOSPITAL PART A COSTS¹

Pneumonia ² PHC		Pneumonia ² Staging		Prostatic Disease ³ PHC		Prostatic Disease ³ Staging	
VIR	-0.17**	A12	-0.08	ABC	0.05	BPH2	-0.01
OTPN	-0.07	BAC2	0.79***	NEOPL	0.47***	BPH3	0.42***
EFF	0.47***	BAC3	0.73***	NEOPOP	0.09**	BPH4	1.34***
LUNCAB	0.44***	TB2	-0.27***	NEOP	0.16***	CAP1	0.12***
FIBR	0.26	ORES	-0.28***	SKEL	0.43***	CAP2	0.12
COPD	0.06**	BR2	-0.07	OPROS	0.51***	CAP3	0.30***
OTHPHC	-0.36***	CA2	0.07	URETS	-0.13*	CAP4	0.52***
COMORB	0.10***	OTH	-0.02	URETO	-0.13***	OTHCA	-0.06
		COMORB	0.13***	CART	-0.20***	OTHGU	-0.03
				OTH	0.00	OTH	0.08***
				COMORB	0.21***	COMORB	0.24***

¹DRCs held constant.²Reference group is uncomplicated pneumonia.³Reference group is uncomplicated BPH.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Source: Merged A-B Medicare Claims Files for Michigan in 1982.

with cancer (CAP1, CAP3, CAP4) are also between 12 and 52 percent more expensive to treat.

All but one of the classes created by PMCs within prostatic disease are significant. Cases identified with cancer are substantially more expensive ranging from 9 percent higher costs for neoplasms with an operation (NEOPOP) to 47 percent higher for neoplasms without an operation (NEOPL). As an exception to this finding, patients with bladder cancer (CART) are 20 percent less expensive to treat. Patients with urethral stricture without an operation (URETO) have costs 13 percent lower.

Another interesting finding is shared by both Staging and PMCs. The dummy variables identifying patients with an unrelated comorbidity are very significant using both the Staging and PMC definitions and their coefficients are approximately the same size. Cases with an unrelated comorbidity are 10 and 13 percent more expensive in the pneumonia cluster and 21 and 24 percent more expensive in the prostatic disease cluster using the PMC and Staging definitions, respectively.

6.0 Conclusion

We have investigated the potential of Disease Staging or PMCs to replace or supplement DRGs as a basis for reimbursing for inpatient services. Neither system alone does as well as DRGs in explaining the variation in costs. However, the results suggest that the systems may prove useful as modifiers to the existing DRGs. Because of the relatively greater sophistication of these systems in using the same diagnostic data as DRGs, they are able to isolate classes of patients within a group of DRGs which have very distinct resource needs. Admittedly, neither system adds significantly to the overall explanatory power of DRGs, although the coefficients on the casemix variables are significant.

Two conclusions may be drawn from these findings. First, casemix severity as we have measured it, accounts for only a small amount of the observed variation. Application of either system as a modifier will have to be selective in identifying classes of patients within DRGs that clearly do not belong. Second, both systems offer the potential for refining a measure of "unrelated comorbidity" that, when incorporated into the existing DRGs, could substantially improve their performance as a measure of casemix.

ATTACHMENT

DISEASE STAGING CATEGORIES

<u>Mnemonic</u>	<u>Percent of cases</u>	<u>Title</u>
<u>PNEUMONIA TRACER</u>		
A12	0.7	Anaerobic infections of lung Stage 2.
BAC2	0.7	Bacterial Pneumonia, bacterimia, hypoxemia, lung abcess, Stage 2.
BAC3	0.5	Bacterial pneumonia, pericarditis, endocarditis or respiratory failure Stage 3.
TB2	0.8	Tuberculosis - moderately advanced pulmonary tuberculosis Stage 2.
ORES	3.4	Other respiratory disease categories, Stages 1, 2, and 3.
BR2	1.4	Bronchitis, persistent or recurrent pneumonia Stage 2.
CA2	0.6	Cancer of the Lung, Stage 2.
OTHDx	17.8	All other disease categories except bacterial pneumonia Stage 1.
COMORB	46.2	Unrelated comorbidity.
<u>PROSTATIC DISEASE</u>		
BPH2	5.5	Benign prostatic hypertrophy with urinary tract infection, obstruction leading to hypertrophy or diverticuli of bladder or atonic bladder, Stage 2.
BPH3	0.3	Benign prostatic hypertrophy with bactermia, metastatic infection, obstruction leading to hydroureters or hyphronephesis, axotemia or shock, Stage 3.
BPH4	0.3	Benign prostatic hypertrophy, death.
CAP1	21.2	Carcinoma of the prostate confined to prostate, causing urinary outlet obstruction or with urinary tract infection, Stage 1.
CAP2	0.3	Carcinoma of the prostate, cancer with local metastases, Stage 2.
CAP3	3.6	Carcinoma of the prostate, with systemic metastases (bone, lung, liver) Stage 3.

<u>Mnemonic</u>	<u>Percent of cases</u>	<u>Title</u>
<u>PROSTATIC DISEASE TRACER</u>		
CAP4	1.9	Carcinoma of the Prostate, death.
OTHCA	1.4	Other cancers, Stages 1, 2 and 3.
OTHGU	13.3	Other genitourinary Stages 1, 2 and 3.
OTHDX	3.0	All other disease categories.
COMORB	50.3	Unrelated comorbidity.

ATTACHMENT

PATIENT MANAGEMENT CATEGORIES

<u>Mneumonic</u>	<u>Percent of cases</u>	<u>Title</u>
<u>PNEUMONIA TRACER</u>		
BAC	82.9	Bacterial pneumonia.
VIR	1.1	Viral pneumonia.
OTPN	4.5	Other pneumonia.
EFF	0.8	Pneumonia with Effusion/empyema.
LUNGAB	0.5	Pneumonia with lung abcess.
FIBR	0.3	Pulmonary fibrosis w/o operation.
COPD	0.8	COPD:pneumonia.
<u>PROSTATIC DISEASE</u>		
BPH	56.6	Benign prostatic hypertrophy.
ABC	0.01	Prostatitis abcess.
NEOPC	0.003	Prostatitis - malignant neoplasm. Local metastases.
NEOPOP	12.0	Prostatitis-malignant neoplasm w/ op.
NEOP	12.0	Prostatitis-malignant neoplasm w/o op.
SKKL	2.9	Prostatitis-skeletal metastases w/o fx.
CART	1.0	Bladder cancer.
URETS	0.01	Urethral stricture without operation.
URETO	0.03	Urethral obstruction with operation.

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